4.5.2 Wildlife

4.5.2.1 Introduction

The following section discusses the environmental setting for Wildlife. The discussion focuses on species and habitat conditions that are most likely to be affected by the Vegetation Treatment Program. Selection of species to assess the need or influence of vegetation treatment program practices on wildlife, plant, and aquatic species is complex given the wide range of species ecological requirements, the variety of vegetation treatment practices potentially applied, and availability of population trend and habitat relationship data. Species and species groups (guilds) were selected for assessment in this chapter based on several criteria. These criteria include species of high public interest, sensitivity to the kind of habitat alteration typically associated with VTP management practices, availability of population data over time, and potential to act as a future population or habitat condition monitoring element to evaluate VTP effectiveness.

The reader is referred to Chapter 5 *Environmental Consequences* for additional discussion of species habitat relationships and the influence of vegetation treatment methods on habitat capability and Table 4.5.2.3 for characteristics of common natural communities authorized for treatment under the VTP. Table 4.5.2.4 identifies rare natural plant communities and occurrence within VTP plant communities.

4.5.2.2 Effect of forest structure on vertebrate species richness and habitat value

In recent decades, some of the most contentious forest management issues have been associated with the amount and distribution of forest conditions (SNEP, 1996). The amount of large, old forests (late successional or old-growth) has been the most notable issue. However, reductions of early successional forests due to management practices such as fire suppression and limited timber management are also a concern. These management actions, along with natural growth and development of forests, have likely contributed to an increase in dense, younger tree canopies and a loss of understory (herbaceous and shrub) vegetation. Forest composition and structure that emphasize dense, young tree canopies has a negative effect on plant and animal species diversity when compared to early and late stages of forest succession or development (Figure 4.5.2).

Loft and Smith (2000) used the California Wildlife Habitat Relationships System (CWHR) to examine the relative species richness and habitat value of forest development and forest canopy cover for 13 habitat types found in the Sierra Nevada. They found that in all five conifer habitats and for each tree size class, CWHR predicted species richness to be greatest in open and sparse canopy condition (less than 40 percent cover). Habitat value (ability of habitat to support species) was highest when canopy cover was less than 60 percent in all size classes.

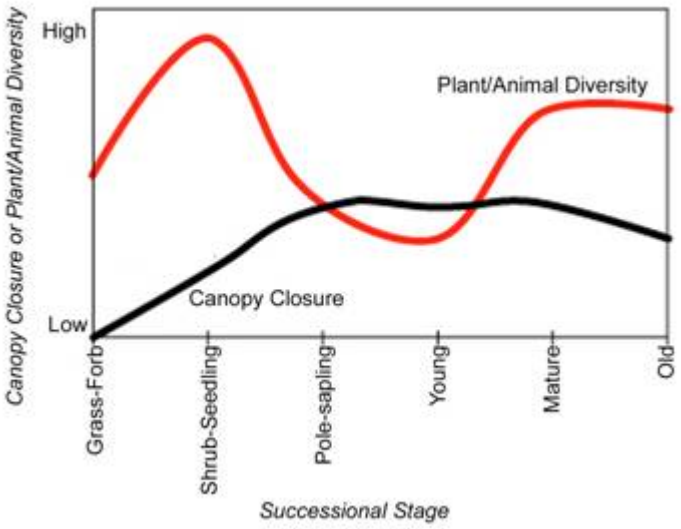

Figure 4.5.2 Plant and animal diversity and canopy closure
Source: Loft and Smith, 2000

Hardwood types showed results similar to the conifer types except both species richness and habitat value were highest in open and sparse canopy conditions (less than 40 percent cover). Shrub and montane riparian types also showed the highest levels of species richness and habitat value in open and sparse canopy conditions and lowest in dense (greater than 60 percent canopy cover) canopy stages.

The possible decline in early and late successional forest habitats with open and sparse canopies may ultimately affect the conservation of terrestrial vertebrate biodiversity. The decline in extent of this land condition and sustainability of herbivores like deer and use by domestic cattle has already been extensively documented. Similarly, 12 of the 51 bird species breeding in shrublands showed a measurable decline in population between 1966 and 2009 (Sauer et al., 2011). This trend may be similar for other early successional animals that are not as closely monitored for change in population status.

4.5.2.3 Population Status and Habitat Relationships of Native Forest and Rangeland Species

Population numbers reported and the trends derived in this section must be interpreted with caution. A variety of variables influences the accuracy and comparability of data collected over time. These include improved information concerning age structure of the population, levels of mortality, estimates of extent and quality of habitat, and other potentially significant and locally specific demographic considerations. Few data sources are available that provide an assessment of statewide or bioregional population trends. Bioregional assessments for a particular class of vertebrate have been completed but generally report on the presence or absence of the species. These vertebrate assessments cover a significant span of time with little data collection in intervening years.

Ungulate Population Trends and Habitat

Pronghorn Antelope

Historically, the pronghorn antelope (*Antilocapra americana*) inhabited most of the grassland, oak woodland, and sagebrush-steppe plant communities in California. The antelope was likely the most abundant big game animal in the State (Pyshora, 1977) and population densities in the San Joaquin Valley may have been the highest in North America. However, by the early 1870s their numbers were significantly reduced due to market hunting, livestock competition, and changing land use practices. In 1923, it was estimated that less than 1,100 pronghorn were present in seven areas of California. By 1943, pronghorn were found only in northeastern California (DFG, 2001f). The population peaked near 8,000 in the mid-1990s and has subsequently fallen to an estimated 3,957 currently (Hobbs, unpublished report 2011).

Population levels have increased from the mid-1940s due to generally favorable weather conditions, increases in acreage devoted to alfalfa and grain crops, reductions in competition for forage with livestock on public lands, and species management practices. DFG and other cooperators are actively involved in establishing new herds in suitable habitat.

Pronghorn are found only in sagebrush, low sage, bitterbrush, grassland, pinyon-juniper, riparian and alkali desert scrub habitats. Browse is an important forage source in all seasons although forbs are heavily utilized in the summer months. This species shows a preference for low, rolling topography in open grassland and sagebrush habitats. Optimal habitat is roughly 40-60% grass, 10-30% forbs, and 5-20% shrub cover

Elk

Three subspecies of elk occur in California. The Roosevelt elk (*Cervus elaphus roosevelti*) inhabits coastal areas in Mendocino, Humboldt, and Del Norte counties in addition to the Cascade and Klamath Mountain Ranges in Siskiyou County. The introduced Rocky Mountain elk (*Cervus elaphus nelsoni*) is found in the Warner Mountains of Modoc County, and southern Kern, western San Luis Obispo, and Shasta counties. The tule elk (*Cervus elaphus nannodes*) occurs in a number of individual herd areas in the coast range, valley floor, and Owens Valley. Collectively, numbers of elk have exhibited increasing trends since the mid 1960s. The greatest increases have occurred within the tule and Roosevelt elk subspecies due primarily to the establishment of new herds by DFG and other cooperators.

Roosevelt elk were once widely distributed throughout northern California. However, by 1925, they were reduced to a small area of Humboldt and Del Norte counties. Elimination of market hunting and public ownership of large tracts of habitat contributed to significant population increases. Relocation efforts by DFG (280 elk since 1985) and natural movement of elk from Oregon into California have resulted in range expansion. Elk now occupy new areas in Mendocino County and the Klamath and Cascade Mountain Ranges of Siskiyou and Trinity counties with significant population increases. They are estimated to have a population of 5,500 (per. comm. Hobbs, 2011).

Of the four populations of Rocky Mountain elk in California, only the population in the Warner Mountains appears to have originated by animals moving into suitable habitat from southeastern Oregon. They have held steady at an estimated 1,500 since 2000 (per. comm. Hobbs, 2011).

Tule elk were undoubtedly the most numerous elk subspecies in California. Historical estimates of early explorers suggest as many as 500,000 elk inhabiting the oak woodland, savannah, and valley floor. However, by the 1860s the effects of habitat conversion to agriculture, market hunting, and competition with livestock reduced numbers and distribution to a small herd in the southern San Joaquin Valley (McCullough, 1969). As a result of an active management program, the population increased to 2,680 by 1989 (DFG, 2007b) and is currently estimated to be 3,900 currently (Hobbs, 2011).

Complete protection of the elk remaining on private lands and subsequent relocation efforts by the California Academy of Sciences contributed to the increase in numbers. This resulted in established herds in three locations by 1940: Cache Creek herd in Colusa and Lake counties; the Owens Valley herd in Inyo county; and the 953 acre enclosure at the Tupman Tule Elk Reserve in Kern county.

Roosevelt and Rocky Mountain elk utilize open, brushy stands of a wide variety of deciduous and conifer habitats with abundant water. Riparian areas, meadows, and herbaceous and brush stages of forest habitats are used for feeding. The tule elk subspecies utilize brush, scrub and herbaceous habitat types throughout the year where they occur in the Owens Valley, Inyo Co. Roosevelt and Rocky Mountain elk exhibit a preference for mature stands of deciduous and conifer forest habitat types. Dense brush understory is an important element on south facing slopes during the winter for thermal and escape cover. Availability of brushy vegetation with opening near water is important for calving.

Deer

Estimated to be between 500,000 to 600,000 before the gold rush, black-tailed deer (*Odocolieus hemionus*) may have increased to as much as 900,000 by the 1950s (DFG, 2001c). They are estimated (based on a population model) to be close to 462,000 currently, and stable in most areas (per. com. M Sommer, 2011). The high deer population levels during that period are the product of large-scale land use and management policy changes that influenced forage quality and direct mortality in the early to mid-1900s. These include the elimination of unrestricted hunting; reduction in predator populations as a result of unregulated trapping and hunting; significant reduction in numbers of domestic livestock grazing on public lands; and the spread of timber harvest and subsequent use of fire as elements in the establishment of shrub fields and other early successional habitats.

Since the mid-1970s, the total deer population in California has remained relatively stable. However, on a local herd or Deer Assessment Unit (several deer herds showing similar management needs and herd conditions) basis, marked declines in deer numbers and habitat quality and availability are evident.

In recent years, deer populations have shown the most marked declines in northeastern California and the northern and central Sierra Nevada Mountains. Several factors are responsible for these declines including habitat loss in quality and quantity, predation, competition with livestock, urban and agricultural development, and illegal hunting. In general, the principal factor influencing deer populations is the availability of quality forage. Habitat quantity and quality continues to decline in the wake of urbanization and other agricultural development in deer habitats (DFG, 2001c).

Deer occupy a wide range of habitat types but generally exhibit a preference for early to intermediate successional stages of most forest, woodland, and shrub habitats. A mosaic of various-aged vegetation that provides woody cover, meadow and shrub cover near water is also preferred. Brushy areas and tree thickets are used for escape cover with slope aspect influencing winter or summer use. Areas of moderately dense shrublands and forests, dense herbaceous stands, and riparian zones with abundant forage and available water are important habitat conditions for fawning.

Bighorn sheep

Two subspecies of bighorn sheep occur in California: Nelson's (*Ovis canadensis nelsoni*) from the Transverse Ranges, Mojave Desert, Sonoran Desert, western Imperial, central Riverside, and eastern San Diego counties; and Sierra Nevada (*Ovis canadensis sierrae*) from the Sierra Nevada Mountains. Both subspecies are currently state-listed, as threatened and endangered respectively, as well as endangered under the federal Endangered Species Act.

It is estimated that 10,000 bighorn, distributed across approximately 100 populations, were present in California in 1800 (DFG, 2001b). However, in the decades following gold discovery, unregulated market and subsistence hunting, and grazing and associated disease transmission from domestic livestock resulted in the loss of several populations in the Sierra Nevada Mountains. Reintroduction efforts in the Lava Beds and Warner Mountains of Modoc County have been unsuccessful due in large part to respiratory diseases contracted from domestic sheep.

Approximately 4,000 bighorn sheep occupied several Mojave and Sonoran Colorado desert mountain ranges in the southeastern portion of the State (per. comm. R. Abella 2011). They are also found in five populations of 160 animals within the eastern Sierra Nevada Mountains and three populations of about 300 individuals in the Transverse Ranges of Ventura, Los Angeles, and San Bernardino counties (DFG, 2001b). Individual population management plans are being developed to identify and protect important habitats, identify future reintroduction sites and limiting factors, and collect demographic data. In 2011 bighorn sheep in the Peninsular Ranges numbered 800 (per. comm. R. Abella, 2011).

In 1996, the Sierra Nevada bighorn sheep population fell to 150 individuals from the 250 recorded in 1979 (Graber, 1996). Compounding the problem is the lack of suitable reintroduction sites in the eastern Sierra Nevada Mountains given domestic sheep and cattle allotments on public lands and potential for disease transmission. Recent population estimates for this subspecies are now at 400 individuals (per. comm. R. Abella, 2011).

Bighorn sheep subspecies utilize a range of habitats in California that include alpine dwarf-shrub, low sage, sagebrush, bitterbrush, pinyon-juniper, palm oasis, desert riparian, desert succulent scrub, desert scrub, sub-alpine conifer, perennial grassland, montane chaparral, and montane riparian. The species graze and browse on a wide variety of plant species although grasses and forbs are preferred for grazing in more open habitats of low growing vegetation. Rocky, steep terrain and canyons are used for escape cover and lambing.

Mammalian Carnivore Population Trends and Habitat

Mountain lion

The mountain lion (*Puma concolor*) is widespread in California and can be found from sea level to alpine meadows, with the general exception of dry areas of the Colorado and Mojave Deserts that do not support mule deer populations and the agricultural areas of the central valley. Approximately 62 percent of California is within the known range of mountain lions. Of that total, approximately 67 percent is considered moderate to highly suitable habitat (Torres et al., 1996). The species is rarely observed in the wild, given their habitat requirements, large home range size, relatively low population densities, and secretive nature.

Estimating the statewide mountain lion population and trends is a difficult task. Regional variation in population densities, habitats used and effectiveness of population monitoring techniques complicate the estimations. Sitton and Wallen (1976) conducted the first major mountain lion study in California and found no evidence to suggest a change from the 1973 DFG estimate of 2,400 mountain lions. However, in the late 1980s, the DFG population estimate was revised to approximately 5,100 with a likely range of 4,000 to 6,000 and that estimate is still relevant (per. comm. M Kenyon, 2011).

These data would suggest that mountain lion numbers have increased over the last 30 years. Coincidentally, there has been an increase in conflicts with California's growing population in rural and largely undeveloped areas. These trends in conflict with rural or urban interface residents and bighorn sheep and other species of concern (Torres, 2000), are regional scale phenomena. They may be representative of growing mountain lion populations, change in habitat conditions, and/or movement of people into suitable mountain lion habitats and do not necessarily suggest a trend in lion populations identifiable at a statewide scale (Torres et al., 1996). More recently, mountain lion depredations, interactions with people, and predation events have decreased in many regions of the State, suggesting regional declines in populations from the mid-1990s (Torres, 2000).

Black Bear

In California, black bears are found in mountainous areas and most commonly inhabit forested and chaparral dominated plant communities (Mixed conifer forests, montane hardwood conifer, chaparral, and hardwood are important habitat types and support the greatest bear densities). Two subspecies are recognized, the northwestern black bear (*Ursus americanus altifrontalis*) and the California black bear (*Ursus americanus californiensis*).

Black bear population numbers in California are apparently increasing. Important demographic measures such as sex ratio of harvested bears, median age, and number of bears harvested indicate increasing population levels. In addition, the illegal take of bears has been greatly reduced from levels seen prior to 1985. Statewide estimates in 1983 were around 7,000 (DFG, 2006, DFG, 2001a), and are now thought to be about 26,000 (+/- 7060) animals (per. comm. M. Kenyon, 2011).

Mesocarnivores

Information on trends in mesocarnivore (fisher and marten) populations is limited in California. However, the conservation of forest carnivores is frequently of concern among wildlife managers and the topic of increasing research effort (snamp.cnr.berkeley.edu/about). Populations of fisher (*Martes pennanti*) within the Sierra Nevada are near the southernmost limits of the species range

and likely occupy marginally suitable habitat. In addition, these areas are where human disturbance on habitat values is the most significant (Lyon et al., 1994). Current populations of marten (*Martes americana*) and fisher may be particularly vulnerable to local extirpation resulting from random demographic or environmental events. They are particularly susceptible to these events given their relatively low ability to colonize new areas of suitable habitat (Lyon et al., 1994). In 2010 DFG announced that the Fisher was not a candidate for designation as a threatened/ endangered species (DFG, 2010).

In California, two populations of fisher are known and occur in northwestern California and the southern Sierra Nevada Mountains and are considered isolated from one another and from populations in other parts of the species distribution. The population status of the Humboldt marten (*Martes americana humboldtensis*) in northwestern California is uncertain (Lyon et al., 1994).

Optimal habitats for marten are various coniferous forest habitat types including red fir, lodgepole pine, subalpine conifer, mixed conifer, Jeffrey pine, and eastside pine. Key habitat elements include the presence of large trees (particularly hardwoods), snags and down logs. Canopy cover that reduces the depth of snow cover on the ground improves accessibility of ground dwelling prey species. Marten utilize small clearings, meadows, and riparian areas for foraging.

Fisher typically occur in intermediate to large tree stages of coniferous forest development as well as deciduous-riparian habitats with a high degree of canopy closure. Stand level characteristics of importance to these forest carnivores include canopy closure, snag and log frequency, and relative proportion of hardwoods and conifers in the stand as an influence on prey density and availability. Klug (1996) surveyed for fisher on commercial timberlands in the redwood zone of Humboldt and Del Norte Counties and noted a positive correlation between fisher detection ratio and greater basal area of hardwoods of all size classes, canopy closure and volume of logs and less conifer basal area in the 52-90 cm size class. Carrol et al., (1999) found a correlation of high fisher detection rates and large hardwoods in a mixed hardwood-conifer forest in northern Humboldt County. Fisher distribution was associated with landscapes with high canopy closure, precipitation (as an influence on prey species composition) and at the scale of the sampling plot, large diameter hardwoods. Large hardwoods provide resting and denning sites and may be associated with higher prey densities given the mast they produce. Landscapes with high levels of canopy closure may influence density and availability of preferred prey, lower energy costs of travel, and protection from predation (Buskirk and Powell 1994; Powell and Zielinski 1994; Carroll et al., 1999).

Bird Population Trends and Habitat

Ground Nesting Game Birds

Ground nesting game birds are native as well as introduced species and include chukar partridge (*Alectoris chukar*), blue grouse (*Dendragapus obscurus*), sage grouse (*Centrocercus urophasianus*), wild turkey (*Meleagris gallopavo*), Gambel's quail (*Callipela gambelii*), California quail (*Callipella californica*), and mountain quail (*Oreortyx pictus*).

Population status of resident game bird species varies with habitat extent and condition. Habitat condition is primarily determined by amounts and timing of annual precipitation and effect on grasses, forbs, and insect populations. Annual surveys to assess population status are conducted

on established routes in selected locales by DFG. Methodologies vary depending on the game bird species, but include water source counts, roadside transects and brood counts, and crowing counts.

Annual hunter kill data and hunter surveys are used as an additional means to assess abundance and to help guide season and bag limit determinations. However, long-term trends in resident game bird hunter participation and associated harvest have exhibited a steady decline since peaking in the 1960s. These trends suggest that both the number of hunters and their harvest will continue to decline or remain stable. For example, the number of quail hunters has declined from a high of 230,000 in 1967 to 65,367 in 2007.

The number of quail harvested has paced hunter numbers with 2.75 million quail bagged in 1964 but only 530,428 in 2007 (DFG 2008). Wild turkey harvest represents a notable difference in this trend with a gradual increase in hunter participation since 1967, which leveled off in the 1990s (Gardner, 2004) and averaged 26,389 between 2003 and 2007 (DFG, 2008). As of 2004 the turkey population was calculated to be 242,000 (Gardner, 2004).

In general, population numbers of these species cannot be precisely determined. Wide variation in numbers in different parts of the species range, level of inventory or census effort, and occupancy of a variety of habitat types in varying degrees of condition make expression of population levels in anything other than a range of expected numbers impossible. North American Breeding Bird Survey (see description below) results for the period of 1966 through 2009 (Table 1) give a general indication of population trend over time.

Wild turkey and California quail exhibit significant positive trends in population over the 1966-1998 period. The remaining species exhibit upward trends though at non-significant levels. Adult spring populations for white-tailed ptarmigan are estimated to be between 2,031 and 8,124 (per. com. S. Gardner 2011). Adult spring populations for ruffed grouse were estimated to be between 8310 and 33,242 (per. com. J. Garcia, 2011). Based on projected fall adult populations, there are approximately 4,124 sage grouse (per. com. S. Garcia, 2011). Sage grouse populations have fluctuated widely due to habitat alteration.

Sage grouse are the only species of special concern among those listed above. The species is found in greatest abundance in a combination of sagebrush, perennial grassland or wet meadow habitats. Sagebrush stands of moderate canopy surround traditional strutting grounds or leks. In addition, sagebrush stands are occupied exclusively in the winter and spring although the species is highly dependent on meadow habitats for forbs and insects in the summer.

Non-game Birds

Non-game and other bird classes represent one taxonomic group where data is available to examine broad scale abundance trends over long periods due primarily to the efforts of the North American Breeding Bird Survey (BBS).

The North American Breeding Bird Survey was established in 1966 to provide breeding bird data in the United States and southern Canada. Bird counting stops are established along secondary roads at 0.5-mile intervals for a distance of 24.5 miles and are visited annually. Because of these systematically collected data, breeding land birds can provide a useful indicator of the status and health of those ecosystems sampled.

Relative abundance trends for California were summarized in two ways (Flather et al., 1999). The numbers of species with statistically significant increasing, decreasing, or stable trends for the State are estimated. Second, species are grouped according to life history characteristics including: nest type and location (cavity, open cup, ground/low, midstory/canopy), migration status (neotropical migrant, short distance, and permanent resident), and breeding habitat (woodland, shrubland, grassland, wetland, and urban) (Peterjohn and Sauer, 1993).

The number of species with increasing, decreasing, or stable trends was also estimated for each life history characteristic. In order to maintain statistical significance, each bird species must have been detected on at least 14 survey routes. For most species, sampling is insufficient to determine population trends; nonetheless, the systematically collected data do provide a useful indicator for those species that are adequately represented on survey routes and at the scale of the State (approximately 46%).

Statewide, the majority of all surveyed species for the period 1966-2009 were decreasing in relative abundance (50 species, 44 percent). The number of species with increasing (28 species, 21 percent) and decreasing trends (35 species, 31 percent) were similar.

Of the 12 life history groups examined, those with the greatest proportion of declining species for the 1966-2009 period are found in the urban (40 percent) and mid-story/canopy (33 percent) groups. The greatest percentage increase for increasing species occurred in wetland (33 percent) and urban (40 percent) life history groups.

Table 4.5.2.1
Bird Population Trend Estimates from 1966 to 2009

Life History Group	% of species w/ sig. negative trend	% of species w/ sig. positive trend	% of species w/ no sig. trend	# of Species
Grassland	20	30	50	10
Wetland	12	33	55	49
Scrubland	24	10	66	51
Woodland	14	22	64	59
Urban	40	40	20	10
Cavity Nesting	14	26	60	35
Open-Cup Nesting	28	14	58	86
Short Distance Migrant	23	18	59	66
Permanent Resident	20	24	56	54
Neotropical Migrant	23	16	61	61
Ground/Low Nest	22	11	67	54
Midstory/Canopy Nest	33	19	48	67

Source: U.S. Geological Survey, 2009

Bird species within the cavity, open cup nesting, and neotropical migrant life history groups are frequently the object of conservation and management initiatives. Managers are concerned for these species given loss of snags, nest parasitism by other bird species, and tropical deforestation and habitat loss respectively. Sixty-one percent of neotropical migrant species exhibited stable

populations during the 1966-2009 period. The percentage of open cup nesting bird species populations considered stable was 58 percent for the 1966-2009 period. Cavity nesting species regarded as stable populations was 60 percent for the 1966-2009 period.

The North American Breeding Bird Survey (BBS) is a key source of information regarding population trends for the majority of North American bird species. However, many features of the survey complicate analyses that seek to go beyond general trends and identify cause and affect relationships influencing bird populations (Sauer et al., 1996).

A variety of environmental factors affects bird populations. Weather conditions, competition with other species, predation, and habitat condition, working either independently or cumulatively affect bird numbers. Similarly, within survey route observer effects, where there is a change in observer or a change in regional survey route coverage, can confound the determination of cause and effect relationships (Temple and Wiens, 1989; Barker and Sauer, 1992).

Although BBS data have been collected in a standardized manner since initiation of the survey, methods of data analysis have changed over time. Several statistical methods have been used to estimate population trends but there is no consensus on which method is most reliable and additional research in this area is required. Prioritization of species conservation efforts based on the statistical significance of trends may vary depending on the data analysis method selected (Thomas and Martin, 1996). Statistical analyses of data and subsequent interpretation are best focused on gross pattern of population change instead of magnitude of calculated trends and variances (Droege, 1990).

The reader is referred to the California Wildlife Habitat Relationships System, maintained by the California Department of Fish and Game, as a readily available source for bird as well as other terrestrial vertebrate habitat relationship and distribution information (http://www.dfg.ca.gov/biogeodata/cwhr/). CWHR contains life history, geographic range, habitat relationships, and management information on 692 species of amphibians, reptiles, birds, and mammals known to occur in the California.

Amphibian and Reptile Trends and Habitat

The North American Amphibian Monitoring Program, although of much more recent origin, is similar in concept to the Breeding Bird Survey and also uses a group of volunteers who complete calling surveys along established routes to determine relative abundance of amphibians.

Over the last two decades, there has been a general decline in many amphibian species in California, North America, and other parts of the world. In some cases, the cause of the decline is proportional to loss of habitat. For other amphibians, the reasons are much less clear. This is particularly true when the decline is noted in undisturbed areas. A variety of factors have been suggested by way of explanation and include ionizing radiation from a depleted ozone layer, estrogenic effects of pesticides as an influence on reproduction, acid precipitation, application of fertilizers and herbicides, introduction of exotic competitors and predators, and infectious diseases (Declining Amphibian Populations Task Force, 2002). Unlike the variety of disturbances that influence aquatic amphibian and reptile (western pond turtle) species, reptile populations are most influenced by habitat conversions (Veirs and Opler, 1998).

True frog and toad species have exhibited the most significant declines. Conservation practices that were previously thought effective, such as setting aside lands from development or reliance on parks or other reserved lands, may not provide the desired results in the face of ecosystem-wide or trans-regional effects. Forty percent of the toad species (four of ten) and 88 percent of the native frog taxa (seven of eight) have been removed from at least 45 percent of their historic California distribution (Jennings, 1995; Veirs and Opler, 1998).

Little comparative baseline data is available to address long-term amphibian population trends in the western United States and California. The documentation of an entire frog fauna declining in a large, diverse region is unprecedented. However, in 1996 Drost and Fellers re-surveyed a Sierra Nevada Mountains transect first conducted by Grinnell and Storer (1924). They included Yosemite National Park in this new survey and found marked declines in the amphibian fauna. Their re-survey indicated that at least five of the seven frog and toad species observed in the original survey have exhibited "serious declines." Two species, the foothill yellow-legged frog (*Rana boylii*) and great basin spadefoot toad (*Scaphiopus intermontanus*), were not observed in the survey area and the mountain yellow-legged frog (*Rana mucosa*), once the most abundant amphibian, has been reduced to a few small remnant populations.

It is likely that a number of different factors are contributing to the documented declines. One possible explanation suggests that the long-term cumulative effects of multiple factors, where natural low points in amphibian population cycles synergize with widespread environmental alterations (e.g., extended drought, chemical pollutants, predation by and competition with non-native species, and disease) will create extinction events (Jennings, 1996; Drost and Fellers, 1996). Recolonization of areas formerly occupied by some Sierra Nevada frog species is unlikely due to the widespread loss of populations and the presence of introduced predators (salmonids and char) (Bradford et al., 1993; Jennings, 1996). Also making recovery difficult is the chitrid fungus *Batrachochytrium dendrobatidis*(Bd). This world wide fungus is believed to have killed numerous frog species and has been found in California (Noda, 2010). *Bd* is a very important organism as it seems to be capable of infecting most amphibians which often leads to chytridiomycosis which is linked to significant population declines and species extinctions (Berger et al., 1998; Skerratt et al., 2007; Fisher et al., 2009).

Amphibian habitat requirements are varied but all are sensitive to desiccation and each species exhibits habitat requirements, life history strategy, or other adaptations that are tied to the availability of moisture in one form or another. Adult California tiger salamanders in their annual grassland habitat spend the majority of the year in subterranean refugia but move to vernal pools and other temporary water sources to reproduce. The species inhabits low elevation vernal pools and seasonal ponds in the associated grassland, oak savannah, and coastal scrub plant communities. Salamanders in the family Plethodontidae occupy terrestrial habitats that provide cool and moist microclimates frequently associated with downed wood, talus, or other site specific structural features and topographic aspect or forest and woodland canopy conditions that provide shade. Forest and woodland dwelling Plethodotid amphibians such as the Del Norte salamander, Ensatina, and slender salamander species do not require standing water and are frequently associated with damp soil conditions found in or near down logs, rock rubble and other structural elements. Eggs are laid on moist surfaces in or under decaying logs and other vegetation or rock fissures. California red-legged frogs use a variety of habitat types, including various aquatic, riparian, and upland

habitats. Virtually any aquatic system ephemeral or permanent may be used provided a permanent water source ideally free from predators is nearby. Habitat breadth for this species is a function of drought and rainfall patterns.

California has a diverse nonmarine reptile fauna, including five freshwater turtles, one tortoise, 38 lizards, and 37 snakes (Stebbins, 1985; Jennings, 1987; Laudenslayer et al., 1991). Three turtle species and one gecko are nonindigenous species. The California population of one native reptile, the Sonoran mud turtle, has probably been extirpated (Jennings, 1987). Many of California's reptiles are common in much of western North America, but there are 14 endemic species (15%) with restricted ranges that include only some part of California or California and a portion of an adjacent state and Baja California (Stebbins, 1985). In addition, many species have one or more subspecies with limited ranges that include a portion of California. Reptile species richness increases from north to south in California, along with an increase in average temperature and aridity. Only a few species are found in the cool, moist northwestern corner of the state, whereas the southern tier of counties hosts a wide array of species (Stebbins, 1985). Unlike the amphibians, which are threatened by factors that often appear to be systemic in nature, most terrestrial reptiles are threatened only by habitat conversion. In general, habitat destruction is the main cause of reptile population declines in California. This is evident because the distribution of species identified by either the state or federal governments as being at risk occurs primarily in areas where the greatest habitat manipulation has occurred in California: coastal urban development, Central Valley agriculture, and desert livestock and recreational habitat alteration (Veirs and Opler, 1998).

The Global Amphibian Assessment (http://amphibiaweb.org/declines/declines.html) provides a search function allowing the reader to examine habitat requirements and other information for all amphibian species of concern in the United States and more specifically California. Similarly, the reader is referred to the California Wildlife Habitat Relationships System, maintained by the California Department of Fish and Game, as a readily available source for terrestrial and aquatic amphibian and reptile habitat relationship information (http://www.dfg.ca.gov/biogeodata/cwhr/). CWHR contains life history, geographic range, habitat relationships, and management information on 692 species of amphibians, reptiles, birds, and mammals known to occur in the state.

Invertebrates

California has a rich terrestrial and aquatic invertebrate fauna that features a high level of endemism and a number of species and groups with specialized life histories or behaviors that, like plants, is likely reflective of the states diverse physical and biological conditions. California supports 34 invertebrate species that are formally listed as either threatened or endangered under state or federal endangered species acts. The list includes 4 gastropods (2 snails, 2 abalone); 8 crustaceans (1 crayfish, 1 freshwater shrimp, and 6 fairy/tadpole shrimp) and 22 insects. Most listed California insects are subspecies of butterflies that occur in extremely localized habitats within 80 kilometers of the coast. Although not formally listed a number of other invertebrates are identified as Special Animals by the California Department of Fish and Game, California Natural Diversity database. Species and subspecies categorized as G1, S1 or G2, S2 are, with current information, thought extremely endangered or endangered. These species or subspecies represent an additional 302 taxa statewide (http://www.dfg. ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf). The exact distribution and population status are not known for most described species.

As elsewhere in the United States, the richest habitats for insects in California occur in areas with at least moderate topographic relief and with the richest array of native woody vines, trees, and shrubs. Such localities are often found along or adjacent to streambeds or valleys at low to moderate elevations in mountainous areas. Invertebrate habitat types that are unique to California or of limited distribution within the United States include coast redwood forest, serpentine grasslands, coastal and riverine dunes, chaparral, evergreen oak woodland, and coastal sage scrub (Veirs and Opler, 1998).

Some California habitats dominated by non native plants exhibit very low populations of native insects, and presumably of other native invertebrates as well. Examples are urban environments dominated by plantings of non native ornamental trees, shrubs, and grasses; Coast Range, Sierra Nevada, or Transverse Range foothills dominated by introduced Mediterranean grasses; or coastal strand and dunes dominated by European beachgrass (Slobodchikoff and Doyen, 1977 fide Veirs and Opler, 1998).

Vernal pools are a unique habitat type in California (see http://www. vernalpools.org/links.htm) and are habitat for a variety of plant as well as invertebrate animal species of concern, particularly the fairy and tadpole shrimp. Many of these plants and animals spend the dry season as seeds, eggs, or cysts, and then grow and reproduce when the ponds are again filled with water. Vernal pools are transitory aquatic habitats, as shallow grassland depressions are filled with winter rains. These depressions are frequently lined with an impervious clay soil layer, slowly drying as the seasons progress; generally being completely dry by late spring. These habitats occur primarily on alluvial formations in the Central Valley. Similar alluvial landscape formations occur in inland valleys of the inner Coast Ranges, and along coastal terraces of Southern California, where geologic forces have lifted the original alluvial landscape surfaces above sea level.

Vernal pools also occur on volcanic mudflows, where rapid weathering of volcanic materials has formed dense clay soils and bedrock near the soil surface. This type of volcanic landscape formations are found in northeast California and in the northern end of the Sacramento Valley.

For additional information on the habitat requirements of certain invertebrate species of concern in California, the reader is referred to Chapter 5 Impact Evaluation and the California Department of Fish and Game Nongame Wildlife Branch, U.S. Fish and Wildlife and National Biological Information Infrastructure web sites and associated links at:
http://www. dfg.ca.gov/hcpb/species/t_e_spp/ teinvert/teinverta. shtml;
http://www.nbii.gov/portal/server.pt/community/invertebrates/1864 and
http://www.fws.gov/endangered/species /us-species.html.

4.5.2.4 Species of Concern

California is the most biologically diverse state in the contiguous United States and one of the most populous. As a result, threats to the continued existence of native species and the natural communities on which they rely are also increasing. Species of Concern as used in this section is a general term that may include formally listed plants and animals as well as those that require additional management attention to prevent formal listing.

The California Department of Fish and Game documents the status of rare, threatened and endangered species and identifies threats to theses species. For 2000, habitat modification, non-native species, and water withdrawals are frequently mentioned threats (DFG, 2000). When categories of threat are ranked by DFG, urbanization of the state's wildlands poses the greatest threat to the continued existence of the endangered flora and fauna (DFG, 1991). Other significant threats to plants include impacts associated with livestock grazing, off-road vehicles, conversion of native habitats to agriculture, competition with non-native plants, and road construction/ maintenance. Other significant threats to animals include impacts associated with water projects, introduced predators and competitors, conversion of native habitats to agriculture, livestock grazing, environmental contaminants, and flood control activities (DFG, 1991).

Over the last 100 years, loss of natural communities such as riparian woodlands, wetlands, native grasslands, and coastal sage exceed 90 percent. In 1991, a preliminary assessment of species status and protection needs conducted by DFG estimated that an additional 60 animals and 600 plants might meet the official listing criteria of the State's Endangered Species Act (ESA).

In 2000, the United States Congress enacted the State Wildlife Grants Program to support state programs that benefit wildlife and habitats and in particular species of greatest conservation need. In response to program requirements the California Department of Fish and Game in partnership with the Wildlife Diversity Project, University of California, Davis directed the development of the state's wildlife action plan (http://www.dfg.ca.gov/wildlife/wap/report.html). This document, incorporated here by reference, sought to identify species and habitats of greatest conservation need, identify those environmental stressors affecting native species and habitats, and identify those actions needed to restore and conserve wildlife in order to minimize the need for future listings as threatened or endangered. The reader is referred to this document for an extensive and thorough bioregional assessment of species at risk, environmental stressors affecting wildlife and habitats, and recommended conservation action.

Species of concern: Formal Listing Trends

The number of listings continues to rise, increasing from 195 taxa in 1987 to 443 in 2010 (Table 4.5.2.2).

Table 4.5.2.2
Cumulative Number of Officially Listed* Taxa, 1987 to 2010**

Year	Plants	Gastropods	Crustaceans	Insects	Fish	Amphibians	Reptiles	Birds	Mammals	Total
1987	118	-	-	-	18	8	9	20	22	195
1990	215	1	2	12	18	8	9	26	25	316
1993	218	1	2	13	18	8	13	28	26	327
2000	254	2	8	20	26	10	13	28	28	389
2005	282	3	8	22	32	15	14	31	35	442
2010	282	4	8	22	33	15	13	30	36	443

**Official listed animal species refers to state listed as threatened or endangered (T&E), federally listed as T&E or on both the state and federal list as T&E. Official listed plant species refers to those that are state listed as threatened, endangered, or rare (TE&R), federally listed as T&E, or both state and federally listed as T&E.*
***includes species, subspecies, distinct populations, evolutionary significant units (ESU) Source: DFG, 2005*

In addition to the official list of endangered, threatened, or rare plant species, the California Native Plant Society (CNPS) in cooperation with DFG maintains a plant inventory that also provides a broad assessment of plant status in California (http://www.rareplants.cnps.org/). These plants include taxa recognized as species, subspecies, or varieties that fall into different categories that range from formal listing to a close association with a habitat type that is declining in California. A recent review of California's flora by CNPS concluded the following:

Twenty-seven plants are presumed extinct (CNPS California Rare Plant Rank 1A);

1,104 are rare throughout their range, have declined significantly, or are judged vulnerable to changing environmental conditions (CNPS California Rare Plant Rank 1B plants);

476 are rare in California but common beyond the State's borders (CNPS California Rare Plant Rank 2 plants);

55 represent problematic taxonomic questions and additional information is needed (CNPS California Rare Plant Rank 3 plants); and

582 are of limited distribution or infrequently occur across a broader area but are considered uncommon (CNPS California Rare Plant Rank 5 plants).

From 1984 to 2001, the number of California plants considered CNPS increased by 417 taxa.

Table 4.5.2.3
Characteristics of Common Natural Communities Authorized for Treatment under the VMP

Common Habitat	Description	Representative Common Wildlife Species	Landscape Distribution in the VMP Project Area	Fire Return Interval (FRI) (years)	FRI Sources
Annual and perennial grassland	Open stand of grasses primarily on flat plains to gently rolling foothills, ridges, and south-facing slopes	Western toad, gopher snake, northern harrier, killdeer, western kingbird, loggerhead shrike, savannah sparrow, pocket gopher, American badger, and coyote	Foothills of the Cascade, Sierra Nevada, and Transverse Ranges	(no data)	--
Coastal scrub	Shrub stands including white sage, black sage, California buckwheat, and California sagebrush	Western fence lizard, orange-crowned warbler, California quail, California thrasher, brush rabbit, Heerman's kangaroo rat, and gray fox	Along the coast north of Santa Barbara County	20-140	White 1995
Sagebrush, low sage, and bitterbrush	Shrub stands dominated by big sagebrush, low sagebrush, bitterbrush, or rabbit brush, and possibly including yellow pines or perennial grasses	Rubber boa, sage grouse, sage thrasher, black-tailed jackrabbit, sagebrush vole, California ground squirrel, and bobcat	East of the Sierra Nevada-Cascade Ranges from Modoc and Siskiyou Counties south to Inyo County	25-50*	Skinner and Chang 1996, Bunting 1994
Montane-hardwood conifer and montane hardwood	Stands with overstory consisting primarily of California black oak, tanoak, Douglas-fir, and madrone, with understory of shrubs and sparse herbaceous layer	Sharp-tailed snake, western rattlesnake, scrub jay, band-tailed pigeon, western gray squirrel, mule deer, and black bear	Cascade, Klamath, Sierra Nevada, South Coast, Transverse, and Peninsular Ranges to 5,800 feet	15-149	Sikinner and Chang 1996, Wills and Stuart 1994
Mixed conifer	Forest stands dominated by associations of ponderosa pine, Jeffrey pine, white fir, incense cedar, Douglas-fir, sugar pine, and black oak	Ensatina, California mountain kingsnake, Steller's jay, western tanager, northern flying squirrel, and Allens' chipmunk	Cascade, Klamath, Sierra Nevada, and Transverse Ranges from 4,500 to 7,000 feet	3-33	Skinner and Chang 1996
Douglas-fir	Forest stands dominated by Douglas-fir overstory and tanoak understory	Pacific giant salamander, northwestern garter snake, western flycatcher, golden-crowned kinglet, varied thrush, Trowbridge's shrew, Douglas squirrel, and dusky-footed woodrat	Coast and Klamath Ranges from Sonoma County north	3-59	Skinner and Chang 1996, Wills and Stuart 1994, Adams 1980
Jeffrey pine, ponderosa pine and eastside pine	Open forest stands dominated by Jeffrey or ponderosa pine	White-headed woodpecker, brown creeper, northern flying squirrel, American martin, and mule deer	Klamath, Cascade, Sierra Nevada, Transverse, and Peninsular Ranges	4-157	Skinner and Chang 1996
Redwood	Forest stands dominated by coastal redwood	Northern red-legged frog, ensatina, Vaux's swift, gray jay, common raven, varied thrush, and western wood pewee, and MacGillivray's warbler	Coast Ranges south to San Luis Obispo County	7-100	Brown and Swetnam 1994, Veirs 1985
Closed-cone pine/cypress	Forest stands dominated by a single species of closed-cone pines, such as Torrey, Monterey, knobcone, or Bishop pine, or	Red-breasted nuthatch, scrub jay, red-tailed hawk, Anna's hummingbird, and gray fox	Coastal California and scattered locations in the Peninsular, Coast, and Sierra Nevada Ranges	15->100	Greenlee and Langenham 1990

	cypresses, such as Tecate, Monterey, or Sargent cypress				
Pinyon-juniper	Woodlands dominated by pure stands of pinyon pine or associations of pinyon and juniper	Pinyon jay, plain titmouse, bushtit, pinyon mouse, and bushy-tailed woodrat	Great Basin from Alpine County to Inyo County, and Transverse, Peninsular, and southeastern Sierra Nevada Ranges	25-50	Bunting 1994
Juniper	Woodland stands of junipers	Chipping sparrow, chestnut-backed chickadee, Cassin's finch, dark-eyed junco, bushy-tailed woodrat, cottontail rabbit, coyote, and mule deer	Great Basin from Siskiyou County to Lassen County, and eastern Sierra Nevada from Lassen County to Fresno County	25-50	Bunting 1994

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* Extrapolated from fire return intervals for eastside pine and juniper woodland types. Fire return intervals in low sagebrush may be as great as 100 years.

Table 4.5.2.4
Rare Natural Plant Communities and Occurrence by Plant Community

	VTP Habitat Type Affinity										
Rare Natural Community	Annual and Perennial Grassland	Coastal Scrub	Sagebrush, Low Sage, and Bitterbrush	Montane Hardwood-Conifer and Montane Hardwood	Mixed Conifer	Douglas-fir	Jeffrey Pine, Ponderosa Pine and Eastside Pine	Redwood	Closed-Cone Pine Cypress	Pinyon-Juniper	Juniper
Valley sink scrub	x										
Valley satlbush scrub	x										
Interior Coast Range saltbush scrub	x										
Coastal terrace prairie	x										
Bald hills prairie	x										
Valley needlegrass grassland	x										
Valley sacaton grassland	x										
Serpentine bunchgrass	x										
Pine bluegrass grassland	x										
Wildflower field	x										
Northern hardpan vernal pool	x										
Northern claypan vernal pool	x										
Northern basalt flow vernal pool	x										
Northern volcanic mud flow vernal pool	x										
Northern volcanic ash vernal pool	x										
Southern interior basalt flow vernal pool	x										
San Diego Mesa hardpan vernal pool	x										
San Diego Mesa claypan vernal pool	x										
Alkali meadow	x										
Alkali seep	x										
North coast black cottonwood riparian forest				x	x	x					
North coast alluvial redwood forest								x			
Red alder riparian forest						x		x	x		
Central coast cottonwood sycamore riparian forest	x	x									
Central coast live oak riparian forest	x										
Central coast arroyo willow riparian forest	x	x									

Rare Natural Community	VTP Habitat Type Affinity										
	Annual and Perennial Grassland	Coastal Scrub	Sagebrush, Low Sage, and Bitterbrush	Montane Hardwood-Conifer and Montane Hardwood	Mixed Conifer	Douglas-fir	Jeffrey Pine, Ponderosa Pine and Eastside Pine	Redwood	Closed-Cone Pine Cypress	Pinyon-Juniper	Juniper
Southern coast live oak riparian forest	x										
Southern arroyo willow riparian forest	x	x									
Southern cottonwood willow riparian forest	x		x								
Southern mixed riparian forest	x		x								
Canyon live oak ravine forest				x	x						
Great valley cottonwood riparian forest	x										
Great valley mixed riparian forest	x										
Great valley valley oak riparian forest	x										
White alder riparian forest				x	x	x					
Aspen riparian forest			x				x			z	x
Montane black cottonwood riparian forest					x		x				
Modoc-Great Basin cottonwood willow riparian forest			x				x				
Sycamore alluvial woodland	x										
Southern sycamore alder riparian woodland		x		x						x	
North coast riparian scrub	x	x		x	x	x					
Central coast riparian scrub	x	x		x	x						
Southern willow scrub	x	x	x							x	
Great valley willow scrub	x										
Great valley mesquite scrub	x										
Buttonbush scrub	x										
Elderberry savanna	x										
Montane riparian scrub				x	x	x	x	x		x	
Modoc-Great Basin riparian scrub			x								x
Hinds walnut woodland				x							
Coastal Douglas fir western hemlock forest						x					
Upland Douglas fir forest						x					
Port Orford cedar forest						x					
Northern bishop pine forest									x		

Rare Natural Community	VTP Habitat Type Affinity										
	Annual and Perennial Grassland	Coastal Scrub	Sagebrush, Low Sage, and Bitterbrush	Montane Hardwood-Conifer and Montane Hardwood	Mixed Conifer	Douglas-fir	Jeffrey Pine, Ponderosa Pine and Eastside Pine	Redwood	Closed-Cone Pine Cypress	Pinyon-Juniper	Juniper
Southern bishop pine forest									x		
Montery pine forest									x		
Monterey cypress forest									x		
Mendocino pygmy cypress forest									x		
Monterey pygmy cypress forest									x		
Northern interior cypress forest									x		
Southern interior cypress forest									x		
Upland Coast Range ponderosa pine forest							x				
Maritime Coast Range ponderosa pine forest							x				
Bigcone spruce canyon oak forest				x							
Northern ultramafic Jeffrey pine forest							x				
Southern ultramafic Jeffrey pine forest							x				
Southern ultramafic mixed coniferous forest					x						
Siskiyou enriched coniferous forest					x						